L Number	Hits		DB	Time stamp
1	111		USPAT;	2003/05/17 14:32
		same (oxygen or oxidizing)	US-PGPUB	
12	59	(((annealing or crystallizing) with PZT)	USPAT;	2003/05/17 15:20
		same (oxygen or oxidizing)) and	US-PGPUB	1
		@ad<19991029		
3	, 7	((annealing or crystallizing) with PZT)	EPO; JPO;	2003/05/17 14:36
	ı	same (oxygen or oxidizing)	DERWENT;	į .
	•	i	IBM_TDB	1
4	3657	438/3,240,253,381,396.ccls.	USPAT;	2003/05/17 15:21
1			US-PGPUB	
5	792	438/3,240,253,381,396.ccls. and PZT	USPAT;	2003/05/17 15:21
			US-PGPUB	
6	409	(438/3,240,253,381,396.ccls. and PZT) and	USPAT;	2003/05/17 15:22
!	!	oxygen and (crystallizing or annealing or	US-PGPUB	
		heating)		<u> </u>

L Number	Hits	Search Text	DB	Time stamp
1	111	((annealing or crystallizing) with PZT)	USPAT;	2003/05/17 14:32
		same (oxygen or oxidizing)	US-PGPUB	
2	59	(((annealing or crystallizing) with PZT)	USPAT;	2003/05/17 14:13
		same (oxygen or oxidizing)) and	US-PGPUB	
		@ad<19991029		
, 3	7	((annealing or crystallizing) with PZT)	EPO; JPO;	2003/05/17 14:36
		same (oxygen or oxidizing)	DERWENT;	
			IBM TDB	i

Page 1

DOCUMENT-IDENTIFIER: US 6066581 A

TITLE:

Sol-gel precursor and method for formation of ferroelectric materials for integrated circuits

------ KWIC ------

Application Filing Date - AD (1):

Brief Summary Text - BSTX (76):

In providing materials, including PZT, for high frequency (microwave) applications, annealing is beneficially carried out in an atmosphere comprising polycrystalline material occurs, and grain sizes growth above about 20 nm were oxygen and ozone, and in the presence water vapour, at lower temperature, i.e. .about.500.degree. C. Under these conditions uniform growth of fine grained not observed. Superior high frequency characteristics were observed for material characterized by uniform small grain sizes.

Brief Summary Text - BSTX (100):

.ltoreq.450.degree. C. for about 30 to 90 seconds, to drive off volatile organic components and to form an amorphous layer. To build up a layer of the required thickness, several thin layers were sequentially deposited and heat about 30 seconds and then heat treated at low temperature, i.e. below The layer of as-deposited material was first dried at 100.degree.

system during the <u>annealing of the PZT</u> by passing <u>oxygen</u> (0.sub.2) through a double bubbler containing purified deionized (DI) water, so that the <u>oxygen</u> was saturated with water vapour, e.g. using a gas flow rate of about 2 L/min. Ozone an annealing atmosphere comprising **oxygen,** preferably in the presence of water vapour, for 30 seconds to several minutes. Water vapour was conveniently latter annealing atmosphere was found to be beneficial for annealing by rapid The resulting amorphous layer was then annealed by a rapid thermal thermal processing, where processing time is relatively short compared with introduced into the annealing atmosphere of the rapid thermal anneal (RTA) treatment is also carried out in the same annealing atmosphere comprising annealing (RTA) process at above 450.degree. C., and up to 650.degree. conventional furnace annealing processes. Beneficially, the first heat is preferably added to the annealing atmosphere to speed up oxidation. oxygen, ozone and water vapour.

Brief Summary Text - BSTX (108):

value<10. Thus, although BST generally requires higher temperature processing than PZT, it has been considered a ferroelectric material of choice for integrated circuit applications at microwave frequencies" which is incorporated herein by reference, a method of preparing PZT with improved high presence of water vapour, at low temperature provide a PZT layer having a fine which frequency the dielectric constant of PZT was observed to drop a very low frequency characteristics by annealing in oxygen and ozone, preferably in the copending patent application Ser. No. 08-410,695 to Chivukala et al., filed Mar. 21, 1995 and now abandoned entitled "Ferroelectric dielectric material for capacitors for GaAs integrated circuits. Nevertheless, as described in processes shows dispersion at high frequencies above .about.100 MHz, above grained structure which shows no significant dispersion up to at least 10 It has generally been observed that the PZT made by known conventional for high frequency applications in the microwave (GHz) frequency range,

Brief Summary Text - BSTX (112):

1-2.times.10.sup.10 dyne/cm.sup.2 that are seen in films annealed in dry oxygen physical properties and electrical properties. In particular, annealing at low temperature 450-500.degree. C. in the presence of water vapour, as compared to ambient at.gtoreq.650.degree. C. Generally, it is found to be advantageous if O.sub.2 or an O.sub.2 /O.sub.3 mixture through purified, de-ionized water into focus of this effort was a reduction of the crystallization temperature of the the rapid thermal anneal (RTA) system during the annealing of the PZT resulted discovery that the presence of water vapour during annealing has a significant PZT from.about.650.degree. C. to<500.degree. C. However, this led to the effect in reducing film stress. The introduction of water vapour by bubbling materials. Nevertheless, it is believed that the film stress is remains high The effect of the introduction of water vapor in the annealing ambient on (2-3.times.10.sup.9 dyne/cm.sup.2) compared to the tensile stress values of reported in the above mentioned copending patent application. The initial relative to bulk material. No significant correlation was found between in crystallization at about 450.degree. C., with improved or comparable the film stress values be kept as low as possible in order to avoid the the stress and crystallization kinetics was studied in the related work problems associated with the peeling of the films and adhesion to other the standard process in dry oxygen, resulted in a lower tensile stress high frequency response and the film stress in the samples.

Detailed Description Text - DETX (75):

formation of **PZT**, with the exception that the **annealing** step was carried out at a higher temperature, between 650.degree. C. and 850.degree. C., and solution was spin coated onto a substrate and heat treated as described for preferably in an atmosphere comprising oxygen/ozone and water vapour using The solutions of strontium nitrate and barium acetate were mixed, and The resultant rapid thermal annealing, as described above for other materials. mixture was added to the titanium iso-propoxide solution.

DOCUMENT-IDENTIFIER: US 5905278 A

Semiconductor device having a dielectric film and fabrication process thereof

TITLE:

α

---- KWIC

Application Filing Date - AD (1): 19970729

Brief Summary Text - BSTX (23):

forming the PZT film 111. It should be noted that the RF sputter deposition of Thus, the oxygen atoms readily reach the conductive plug problem of diffusion of Pb and $\frac{\mathsf{oxygen}}{\mathsf{vime}}$ atoms from the PZT film 111 to the lower capacitor electrode 110 at the time of the RF sputtering process used for O.sub.2. A similar problem of $\underbrace{\texttt{oxygen}}_{\texttt{annealing}}$ diffusion occurs also when applying an $\underbrace{\texttt{annealing}}_{\texttt{process}}$ to the $\underbrace{\texttt{PZT}}_{\texttt{film}}$ film 111 after a formation thereof. It should be conventionally used Ti layer is found to be not effective for interrupting the Further, the use of a Ti layer in the lower capacitor electrode 110 causes the noted that such an annealing process is essential for improving the quality of material such as Pt or Ti does not function as an effective diffusion barrier the PZT film 111 and has to be conducted in an oxidizing atmosphere, while the PZT film 111 is conducted under an oxidizing atmosphere that contains diffusion of Si from the plug 115 to the lower capacitor electrode 110. In relation to the diffusion barrier, it should be noted that the against **oxygen** atoms.

When this 115 underneath the electrode 110 and cause an extensive formation of silicon oxide at the interface between the plug 115 and the electrode 110. When this occurs, there is a substantial risk that the ohmic contact between the electrode 110 and the conductive plug 115 is lost.

DOCUMENT-IDENTIFIER: US 6194228 B1

TITLE:

Electronic device having perovskite-type oxide film, production thereof, and ferroelectric capacitor

----- KWIC ------

Application Filing Date - AD (1): 19981021

Detailed Description Text - DETX (11):

at a flow rate of about 5 L/min, with the temperature raised to 650.degree. C. at a rate of 1.degree. C./s, kept at 650.degree. C. for 30 minutes, cooled to 200.degree. C. over a period of 30 minutes, and finally cooled naturally. The PZT film obtained by repeated spin coating and thermal decomposition is atmosphere containing **oxygen**. This heat treatment may be carried out in an annealing apparatus having a capacity of about 20 liters, by supplying **oxygen** crystallized by heat treatment (such as lamp annealing) in an oxidizing

Detailed Description Text - DETX (41):

annealing) in an oxidizing atmosphere containing oxygen. This heat treatment may be carried out in such a way that the temperature is raised to 650 degree. The thus obtained PZT film is crystallized by heat treatment (such as lamp C./s and kept at this temperature for 2 minutes. C. at a rate of 100.degree.

05/17/2003, EAST Version: 1.03.0002

In this way there is obtained a polycrystalline PZT film 6.

DOCUMENT-IDENTIFIER:

US 6146905 A

TITLE

Ferroelectric dielectric for integrated circuit applications at microwave frequencies

KWIC

Application Filing Date - AD (1):

19990617

Brief Summary Text - BSTX (17):

GHz range relative to the roll-off in dielectric constant which occurs at about it was discovered that the frequency response of the PZT was extended into the 100 MHz in bulk ceramic PZT. Consequently, the usefulness of this material as integrated circuits operable at microwave frequencies. In other applications, providing PZT films with high dielectric constant >300 and low film stress, these fine grained polycrystalline PZT may be used for high frequency surface <u>annealing,</u> by rapid thermal processing, in an <u>oxygen</u> and ozone containing atmosphere, and preferably in the presence of water vapour. In addition to In preparing PZT films having high frequency performance above 1 GHz, a temperature method was employed, for example a sol-gel process, comprising a ferroelectric dielectric, is extended for use, e.g. for capacitors for acoustic wave (SAW) devices having low mechanical loss.

Detailed Description Text - DETX (2):

patent application Ser. No. 08-348848, using a known spin-on liquid process to apply to the substrate a metallorganic sol-gel precursor comprising amorphous layer was then annealed by a rapid thermal annealing (RTA) process at anneal (RTA) system during the annealing of the PZT by passing oxygen (0.sub.2) through a double bubbler containing purified deionized (DI) water, so that the In a method of forming a ferroelectric dielectric for a capacitor structure semiconductor silicon wafer. A bottom electrode of a capacitor was defined on temperature, i.e. below .ltoreq.450.degree. C. for about 90 seconds, to drive off volatile organic components and to form an amorphous layer. The resulting preferably in the presence of water vapour, for 300 seconds. Water vapour was oxygen was saturated with water vapour, e.g. using a gas flow rate of about 2 sputtered platinum. A layer of lead zirconate titanate (PZT) was then formed capacitor structure was formed on an integrated circuit substrate comprising alternatively comprises a multilayer structure including a barrier layer and the substrate. The bottom electrode comprises a single conductive layer, or constituents of the ferroelectric material, i.e. an inorganic lead compound, thickness was obtained by sequentially depositing and heat treating several adhesion layer. In the present example a bottom electrode was formed from conveniently introduced into the annealing atmosphere of the rapid thermal on the bottom electrode as described in the above mentioned copending U.S. thin layers. Each layer of as-deposited material was heat treated at low according to a first embodiment of the present invention, a ferroelectric and zirconium and titanium alkoxides in the desired proportions, e.g. to provide a 40:60 ratio of zirconium to titanium. A layer of the required 450.degree. C. or higher, in an annealing atmosphere comprising oxygen, L/min. Ozone is preferably added to the annealing atmosphere to speed

Detailed Description Text - DETX (8):

focus of this effort was a reduction of the crystallization temperature of the ambient on the stress and crystallization kinetics was studied. The initial Application, the effect of the introduction of water vapor in the annealing In related work reported in the above mentioned copending Patent

temperature 450-500.degree. C. in the presence of water vapour, as compared to the standard process in dry **oxygen**, resulted in a lower tensile stress (2-3.times.10.sup.9 dyne/cm.sup.2) compared to the tensile stress values of 1-2.times.10.sup.10 dyne/cm.sup.2 that are seen in films annealed in dry **oxygen** C. However, this led to the physical properties and electrical properties. In particular, annealing at low ambient at .ltoreq.650.degree. C. Generally, it is found to be advantageous if discovery that the presence of water vapour during annealing has a significant O.sub.2 or an O.sub.2 /O.sub.3 mixture through purified, de-ionized water into the rapid thermal anneal (RTA) system during the annealing of the PZT resulted relative to bulk samples. Differences in the thermal expansion coefficient of effect in reducing film stress. The introduction of water vapour by bubbling materials. Nevertheless, it is believed that the film stress is remains high the ferroelectric dielectric film and the substrate contributes to the stress levels in thin films. No significant correlation was found between the high in crystallization at about 450. degree. C., with improved or comparable the film stress values be kept as low as possible in order to avoid the problems associated with the peeling of the films and adhesion to other frequency response and the film stress in these samples. C. to <500.degree. PZT from .about.650.degree.

Detailed Description Text - DETX (31):

compared. A bottom electrode comprising 2000 .ANG. platinum was deposited, followed by a blanket layer of 1800 .ANG. PZT, and a top electrode comprising platinum patterned by a lift off technique. The PZT was deposited by two coatings, each of which were annealed for 90 seconds at 450.degree. In another set of **PZT** samples prepared under different conditions, the effect of **annealing** in wet and dry **oxygen**, with and without ozone were C. for 5 Dielectric constants were measured as shown in Table I. followed by a third coating and an final anneal at 450.degree. minutes.